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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 10/631,238 | 07/31/2003 | Sung Hoon Lee | 29936/39433 | 1737 |

4743 7590 05/26/2005

MARSHALL, GERSTEIN & BORUN LLP
233 S. WACKER DRIVE, SUITE 6300
SEARS TOWER
CHICAGO, IL 60606

EXAMINER

VINH, LAN

ART UNIT PAPER NUMBER

1765

DATE MAILED: 05/26/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/631,238

Applicant(s)

LEE, SUNG HOON

Examiner

Lan Vinh

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 31 July 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-11 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-11 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-3, 9 are rejected under 35 U.S.C. 102(b) as being anticipated by Chuang (US 5,937,309)

Chang discloses a method of forming STI structure. The method comprising the steps of:

sequentially forming a pad oxide film 205 and a pad nitride film 210 on a semiconductor substrate (col 2, lines 46-48)

removing the pad nitride film and the pad oxide film on an isolation region so that protrusions of a tail profile are formed at the top corners of the isolation region (col 2, lines 62-64; fig. 2C)

etching the semiconductor substrate of the isolation region, while using the protrusions as an anti-etch film, to form a trench the top corners of which are made rounded (col 3, lines 25-32)

burying the trench with an insulating material and then removing the pad nitride film and the pad oxide film on the semiconductor substrate to form an isolation film (col 1, lines 41-45; col 3, lines 60-65)

Regarding claim 2, Chuang discloses the step of implementing an over-etch process using a CHF₃ gas to remove the nitride layer (col 3, lines 30-35)

Regarding claim 3, fig. 2C of Chuang shows performing an etch step to etch oxide layer 225 without etching nitride layer 210, which reads on implementing an etch process with a high selectivity for removing the pad nitride film and the pad oxide film

Regarding claim 7, Chuang discloses the step of performing a photolithography process on the substrate (col 2, lines 62-63) and Chuang is silent about any polymeric residuals, which reads on wherein a photoresist pattern is formed on the pad nitride film in order to define the isolation region, and wherein the photoresist pattern is removed before the trench is formed after the pad nitride film and the pad oxide film on the isolation region are removed, so that polymer occurring from the photoresist is prevented to affect an etch process for forming the trench.

Regarding claim 8, Chuang is silent about removing the substrate from the etch chamber which reads on wherein the etch process for forming the trench is implemented in-situ with no time delay at the etch chamber by which the pad nitride film and the pad oxide film are removed, in order to prevent a native oxide from being formed on the semiconductor substrate of the isolation region.

Regarding claim 9, Chuang discloses the steps of
performing a first etch process for the semiconductor substrate only with a process condition having a high selectivity ratio to the protrusions to form the trench the top corners of which are not made rounded (fig. 2C)

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performing a second etch process, using a post etch treatment (PET) with a process condition having a low selectivity ratio to the protrusion, to form etch tilt faces at the top comers of the trench while removing the protrusions, thereby forming the trench that is made rounded (col 3, lines 25-32; fig. 2C)

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. Claims 4-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chuang (US 5,937,309) in view of Bamnolker et al (US 6,890,859)

Chuang method has been described above. Unlike the instant claimed inventions as per claims 4-5, Chuang fails to disclose using a CF₄ gas and a CHF₃ gas as an etch gas and wherein the CHF₃ gas is more supplied than the CF₄ gas so that the selectivity

ratio to oxide is increased and wherein the supply ratio of the CHF₃ gas and the CF₄ gas is 2:1 - 10:1

Bamnlker discloses a method for forming semiconductor structure comprises the step of using a CF₄ gas and a CHF₃ gas as an etch gas and wherein the CHF₃ gas is more supplied than the CF₄ gas and wherein the supply ratio of the CHF₃ gas and the CF₄ gas is 2 (col 6, lines 33-35)

One skilled in the art at the time the invention was made would have found it obvious to modify Chuang method by using a mixture of CF₄ gas and a CHF₃ as per Bamnlker because Bamnlker discloses that the number of cone-shaped defects generated in the silicon trench is reduced when the ratio of the flow rate of the CF₄ and CHF₃ is changed from one to two (col 6, lines 31-35)

Regarding claim 6, Chuang fails to disclose the step of setting a time point when an oxide component of the pad oxide film is detected as an end-point. Bamnlker also discloses determining end point during the oxide etch step (col 7, lines 50-52). One skilled in the art at the time the invention was made would have found it obvious to modify Chuang by setting a time point when an oxide component of the pad oxide film is detected as an end-point because Bamnlker discloses that determination of the various end point (oxide etch time) can be made by employing one of the techniques which are well known in the art (col 7, lines 50-55)

5. Claims 10-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chuang (US 5,937,309) in view of Chen (US 6,500,727)

Chuang method has been described above. Unlike the instant claimed inventions as per claims 10-11, Chuang fails to disclose wherein the etch selectivity ratio to the protrusions and the semiconductor substrate is controlled by adjusting/increasing the flux of an HBr gas among etch gases

Chen discloses a silicon etching method comprises the step of using an etching mixture of HBr and CHF₃ and adjusting the flux of an HBr gas among etch gases (col 2, lines 45-51)

Since Chuang is directed to a method to form trench having round corner, one skilled in the art at the time the invention was made would have found it obvious to modify Chuang method by using an etching mixture of HBr and CHF₃ and adjusting the flux of an HBr gas as per Chen because Chen discloses using the plasma etch using HBr and preferably a hydrofluorocarbon to form trench with upper rounded corners (col 2, lines 33-49)


Conclusion

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 571 272 1471.

The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571 272 1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



LV
May 24, 2005